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Federal Reserve Bank of Cleveland

# How Well Does the Federal Funds Futures Rate Predict the Future Federal Funds Rate?

by Ed Nosal

In order to meet their reserve requirements, banks often borrow money for short periods (typically overnight) to make up transitory cash shortfalls. Usually, they borrow in the federal funds market from other banks that have excess reserves on hand. The interest rate that is paid on these borrowed reserves is called the *federal funds rate*. When the Federal Reserve announces a change in interest rates, this is the rate that it attempts to change. The Fed cannot perfectly control the rate because it is determined by supply of and demand for reserves. What the Fed does instead is set a target rate and then buy or sell government securities (open market operations) so that the actual federal funds rate is, on average, equal to the target.

The Fed's target interest rate on federal funds is followed closely, and expected changes in the future rate can affect the behavior of individuals and institutions. For example, if banks expect the fed funds rate to increase, they will hold, on average, less reserves. Businesses other than banks may be concerned about rate changes, too, since changes in the fed funds rate may ultimately affect the interest rates they care about. Business and investment decisions depend, in part, on what companies expect these rates will be in the future. For example, suppose a company must decide today whether to undertake a project in the future. Its decision will be affected by

its perception of future borrowing costs. If future borrowing costs are related to the future fed funds rate, then the company may choose not to undertake a project that is profitable at current borrowing rates if it expects the fed funds rate to be higher in the future. Alternatively, it may choose to undertake a project in the future that is unprofitable at current borrowing rates if it expects the fed funds rate to be lower in the future.

Movements in the fed funds rate expose banks and other businesses to risk. In the case of banks, rate changes directly affect their cost of overnight borrowing. For others, fed funds rate changes may mean interest rates on business loans or investments will change, too. Banks can hedge against fed funds interest rate risk by participating in the fed funds futures market. Since other businesses often are not directly affected by the fed funds rate, this futures market may not be an ideal hedging vehicle for them. However, the rate at which fed funds futures are selling may provide information that can help determine what the future rate might be on instruments that do concern them.

Businesses use the rates on fed funds futures to forecast future fed funds and other interest rates. But how closely is the futures rate related to what the fed funds rate turns out to be? We have reason to believe that the futures rate on average overpredicts the fed funds rate, and, over different phases of the business cycle, may systematically over- or underpredict the eventual fed funds rates.

**Contrary to popular belief, federal funds futures rates do not tell us precisely where the market thinks federal funds rates will be in the future. On average, futures rates overpredict future fed funds rates, and, depending on whether fed funds rates are falling or rising, the futures rate may consistently overestimate or underestimate the future fed funds rates. To obtain a reliable estimate of the future fed funds rate, one must adjust the fed funds futures rate appropriately to account for the bias and past movements of the fed funds rate.**

## ■ The Federal Funds Futures Contract

The federal funds futures contract is an interest rate futures contract that is based on the average federal funds rate over a particular calendar month. A contract can be written for any month up to 24 months in the future. The standard contract has a notional value of \$5 million, and contracts are settled on a daily basis.

Conceptually, it is best to think of a futures contract as specifying that a certain good or asset is to be delivered at some future date at a pre-set price, the *futures price*. A fed funds futures contract can then be interpreted as specifying that one bank delivers an overnight loan to another bank at some future date at a predetermined interest rate, the *federal funds futures rate*. By entering into

a fed funds futures contract a bank is able to essentially “lock in” a rate for future borrowing or lending.<sup>1</sup>

### ■ The Fed Funds Futures Rate and the Expected Future Fed Funds Rate

It is quite sensible to conjecture that the expected future fed funds rate is somehow related to the fed funds futures rate. (If it were not, the fed funds futures market would not be efficient.) But should one simply interpret the fed funds futures rate as the fed funds rate that “the market” actually expects to prevail in the future?

In theory, there are reasons to believe that the fed funds futures rate will typically overestimate the future fed funds rate. To understand this, note that, while futures contracts can help minimize risk, they are nonetheless financial instruments that promise to deliver (other) financial instruments that do carry *some* risk. Incorporated into the futures rate is a premium for compensating buyers for this risk. The following example should make this idea clear.

Consider a futures contract on a pure discount bond. A pure discount bond provides its holder with a single payment upon maturity. I use the example of a pure discount bond because the federal funds rate applies to a financial instrument—an overnight loan—that is, in fact, a pure discount bond with maturity of one day. Suppose that someone enters into a futures contract that requires him to deliver a pure discount bond that matures in 90 days, where delivery will occur 30 days from now. At maturity the bond will pay \$100. He can ensure he has something to deliver by purchasing a 120-day pure discount bond *today* and holding it for 30 days: After 30 days the 120-day pure discount bond *becomes* a 90-day pure discount bond.

As we shall see, this buy-and-hold strategy will tell us what the futures price should be. In particular, if the 120-day pure discount bond costs \$95 and the interest cost associated with financing a \$95 loan for 30 days is \$1, then the total cost associated with the buy-and-hold strategy is \$96. (Note that the financing cost is relevant even if one has the \$95

in hand because, by purchasing the 120-day pure discount bond, one foregoes the \$1 that could have been earned.) The buy-and-hold strategy ensures that a 90-day pure discount bond will be delivered in 30 days. Since the cost of the buy-and-hold strategy is \$96, no one would be willing to pay more than \$96 for a 90-day pure discount bond 30 days from now. Hence, the futures price—the price that someone pays for delivery of a 90-day pure discount bond delivered 30 days from now—must be \$96.

Continuing with the example, one can interpret the futures contract as providing a return of \$1 *for sure* to anyone who delivers a futures contract using the buy-and-hold strategy. The *actual* return associated with a 120-day pure discount bond 30 days from now, however, is uncertain: The price may turn out to be \$96, but it could also be \$94 or \$98. Given that people generally do not like risk, they will be willing to purchase the 120-day pure discount bond today (without any offsetting futures contract) only if the price of the bond is expected to exceed \$96 in 30 days. That is, an individual must be compensated for the “risk” that is inherent in the bond before its maturity date, implying that the expected 30-day return must be greater than the \$1 that can be earned for certain. As a result, the expected price of the 120-day pure discount bond 30 days from now—which is simply the current price plus its expected 30-day return—must exceed \$96. Suppose that the expected price of the 120-day pure discount bond 30 days from now is \$97, implying an expected 30-day return of \$2. Therefore, the futures price, \$96, *underestimates* the price that is expected to prevail in the future, \$97.

Because there is a simple inverse relationship between bond prices and returns, the futures rate *overestimates the rate* that is expected to prevail in the future. Note that the rate we refer to is the rate of return associated with a 90-day pure discount bond that pays \$100 at maturity. If one purchases the 90-day pure discount bond for \$96, which one is able to do via a futures contract, then the rate of return on the 90-day pure discount bonds is 4.2 percent over 90 days (the \$4 one earns is 4.2 percent of the \$96 invested). On the

other hand, if one purchases the 90-day pure discount bond on the open market for \$97, the expected return is 3.1 percent over 90 days (\$3 is 3.1 percent of \$97). Hence, the futures rate of return of 4.2 percent exceeds the expected rate of return of 3.1 percent.

Theory suggests that the fed funds futures rate overpredicts the expected future fed funds rate. Is this consistent with the data? Before we can answer this question, we must grapple with an empirical issue: We must decide how we’ll measure what the market *expects* the future fed funds rate to be. For our purpose, we will assume that futures rates do represent the market’s expected future fed funds rate. The following approach is taken. We’ll compare the average difference between futures rates on contracts that mature in a given month and the average fed funds rate that prevailed during that month.

For example, consider a four-month fed funds futures contract (delivery of the funds will occur four months from when the contract is signed). If the rate on this contract is 3.4 percent on December 31, 1993, it means, loosely speaking, that a bank entering into the contract must either accept or make delivery, depending on whether it bought or sold the contract, of an overnight loan on April 30, 1994, at an interest rate of 3.4 percent. The fed funds rate for April 1994 turns out to be 3.548 percent. So, in this instance, the difference between the fed funds futures rate and the fed funds rate is  $-0.148$ . We apply this procedure for all months between April 1989 and October 2001. This enables us to calculate the average difference between the fed funds futures rate and the actual fed funds rate.

Over the period April 1989 to October 2001, the fed funds futures rate exceeded the future fed funds rate by 0.187 percent *on average*, and this difference is statistically different from zero. Hence, on average, the data are consistent with the theory; the futures rate exceeds the expected rate. This suggests that if someone wants to make an educated guess as to what the fed funds rate will be in four months, he should subtract 0.187 percent from the current four-month fed funds futures rate. Subtracting 0.187 percent removes

FIGURE 1 THE FED FUNDS RATE AND THE ADJUSTED FED FUNDS FUTURES RATE



a. The adjusted rate is the monthly average of the daily fed funds futures rate minus 0.187, the average amount by which the futures rate overpredicted the fed funds rate from April 1989 to October 2001.

b. Daily fed funds rates were averaged for each month.

SOURCES: Board of Governors of the Federal Reserve System, *Federal Reserve Statistical Releases*, "Selected Interest Rates," H.15; Chicago Board of Trade; and Bloomberg Financial Information Services.

the bias contained in the fed funds futures rate. If one plots the "adjusted" fed funds futures rate—the fed funds futures rate minus 0.187 percent—and the fed funds rate over time, one might expect that the two series should closely resemble one another. After all, when the bias is removed, the average "adjusted" fed funds rate *equals* the actual average funds rate.

The two series are displayed in figure 1 and, perhaps surprisingly, they do not closely resemble one another. The figure has two rather striking features. First, when the fed funds rate is falling (for example, 1991–1993, and from 2001 onward), the futures rate tends to *overestimate* the fed funds rate, and when the fed funds rate is rising (for example, 1994–1995 and 1999–mid 2000) the futures rate tends to *underestimate* the target rate.

These systematic biases do not necessarily reflect some inefficiency in the futures market. To see this, suppose that the Fed has recently cut the target fed funds rate after a period of unchanging targets, and you have to forecast the fed funds rate four months into the future. Given the information that you currently

possess, it is unlikely that you will be able to conclude *for certain* that the Fed will either initiate another cut or keep the fed funds rate unchanged in the future. Both of these events are possible. (Since the Fed just cut the fed funds target rate after a period of unchanging target rates, you are pretty certain that the Fed will not increase the target rate in the near future.) So, when you form your forecast of the future fed funds rate, it will be a weighted average of the current fed funds rate (that is, the Fed does not cut the target in the future) and a lower fed funds rate (the Fed does cut the target in the future). If the Fed, in fact, ends up cutting the fed funds rate in the future, your forecasted fed funds rate will be higher than the actual fed funds rate. To the extent that the fed funds future market embodies these expectations, the fed funds futures rate may systematically overestimate the future fed funds rates when fed funds rates are falling and, by symmetry, underestimate the future fed funds rate when fed funds rates are rising.

#### ■ Summary

What do fed funds futures rates tell us about future fed funds rates? The futures rate *does not* tell us where the

market thinks rates will be in the future. Fed funds futures rates, on average, overpredict future fed funds rates. Even if this bias is removed, which implies that, on average, fed funds futures rates are equal to future fed funds rates, the fed funds futures rate does not provide one with a reliable estimate of future fed funds rates at a particular point in time: Depending on the future course of the fed funds rates, the futures rate may either consistently overestimate or underestimate future fed funds rates.

This is not to say that the fed funds futures rate does not contain any information about the market's expectation of the future course of policy. In fact, it does contain a great amount of information. However, in order to obtain a reliable estimate of the future fed funds rate, one must make appropriate adjustments to the fed funds futures rate to take account of the biases and past movements of the fed funds rate.

#### ■ Footnotes

1. Of course, in practice the asset that underlies a futures contract is not delivered. Instead, contracts are settled in cash.

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